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Antimicrobial properties of *Lawsonia inermis* syn. *Lawsonia alba in vivo* and *in vitro*

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Abstract

People in rural areas use plant materials to cure various diseases, because most of the plants contain components of therapeutic value. Among the important medicinal plants included *Lawsonia inermis*, syn. *L. alba* (henna). Scientific research on henna plant has proven many beneficial properties in henna. The henna plant extract has a variety of biological activities such as anticomplementary, anti-inflammatory, analgesic, and antimicrobial activities. Chemical compound in henna is lawsone ($C_{10}H_6O_3$), the active ingredient and a naturally occurring naphthoquinone. Plant tissue culture is the process of plant cell growth outside an intact plant. Research in the area of plant tissue culture technology has resulted in the production of many pharmaceutical substances for new therapeutics. The aim of this paper was to investigate possible antimicrobial activities of henna and to compare the activities in *in vivo* (normal) henna plant and *in vitro* (tissue culture) henna plant. Tissue culture studies of henna were carried out by using different concentrations and combinations of hormones. Then, the antibacterial activities of ethanolic extracts of henna *in vivo* and *in vitro*, on some bacteria and fungal strains, were screened using the modified agar well diffusion method. In this work *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus cereus* and *Eschericia coli* were used as bacterial strains and fungal strains *Candida albicans*, *Aspergillus niger*, *Trichoderma* sp. and *Fusarium* sp. were used. Data were expressed as mean±standard deviation. Research on *in vivo* and *in vitro* plants were compared because previous studies on plant tissue cultures showed that it has potential as a supplement to traditional medicine, especially in the industrial production of bioactive compounds from plants.

Key words: Tissue culture, naphtoquinone, antibacterial activity, ethanolic extracts, bioactive compounds.

Introduction

Medicinal and herbal plants which contain components of therapeutic properties have been used as remedies for human diseases for centuries. Plants can produce antifungal compounds to protect themselves from biotic attack that could be essential for fungi infection resistance [17]. Plant also are rich in a wide variety of secondary metabolite polyphenols, such as tannins, terpenoids, alkaloids, and flavonoids, which have been demonstrated to have *in vitro* antimicrobial properties [4].

Lawsonia inermis syn. *Lawsonia alba* is one of the important herbal and medicinal plant. The plant belongs to the family Lythraceae, and is widely cultivated and used in many oriental, middle eastern and northern African country [6]. The henna plant extract has a variety of biological activities such as anti-inflammatory, analgesic, and antimicrobial properties [6]. Previous studies by Ahmed *et al.* [1] also showed that henna possess antimicrobial activity, antitubercular activity, and anti inflammatory activity.

Chemical compound in henna is lawsone ($C_{10}H_6O_3$), the active ingredient and a naturally occurring naphthoquinone. Studies on antibacterial activities of the natural naphtoquinones showed that, they are active against Gram positive bacteria such as *Staphylococcus aureus, Enterococcus faecium* and *Bacillus subtilis* [13]. Tissue culture studies showed that a compound produced from *in vivo* plant could be produced at the same or different levels or not produced at all [16].

There are many study on antimicrobial efficacy of henna extracts. Malakzadeh [11] reported that inhibitory effect of henna was shown both in Gram positive and Gram negative bacteria. Experiment on crude extract of dry and fresh Omani henna leaves and seeds possessed antimicrobial properties against all microorganisms tested [7].

However, there are lack of study, regarding production of antimicrobial properties of henna plant using *in vitro* propagation techniques. Production of secondary metabolites using *in vitro* propagation techniques has been studied by Al-Abta *et al.* [2] in celery plant and the results showed different amount of compound produced in differentiated and undifferentiated callus tissues. The variety of compounds produced in *in vivo* and *in vitro* plants can show different bioactivity potentials [5] and this is similar with the bioactivities, it will differ between *in vitro* and *in vivo* grown plants [10].

Present study is done to investigate if plant tissue culture can be a reliable tool for the mass production of therapeutic compounds of antimicrobial properties in henna plant. In this study, the